United States
Department of
Agriculture

**Forest
Service**

Forest
Products
Laboratory

Dividends From Wood Research

Recent Publications

January–June 1996

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer between January 1 and June 30, 1996.

Each publication listed in this brochure is available through at least one of the following sources.

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail or FAX the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

Biodeterioration and Protection

Proceedings of the International Research Group of Wood Preservation; 26th annual meeting; 1995 June 11–16; Helsingor, Denmark. The Reserach Group on Wood Preservation

Available from IRG Secretariat, Box 5607, S–114 86 Stockholm, Sweden. Cost: about 150 Swedish crowns/item.

Dimensional Lumber Model Demonstrates the Sensitivity of the Particile Capture Immunoassay in Early Detection of Brown-Rot Fungi by Clausen, Carol A.; Ferge, Leslie.

Basidiosporogenesis by Brown-Rot Basidiomycetes *in vitro* by Croan, Suki, C. Document IRG/WP/95–10126.

Hydrolysis of Bordered Pits During Colonization of Conifers by Brown-Rot Decay by Green, F., III.; Tschernitz, J.; Kuster, T.A.; Highley, T.L. Document IRG/WP/95–10103.

The Long Road to Understanding Brown-Rot Decay—A View From the Ditch by Green, Frederick III; Highley, T.L. Document IRG-WP95-10101.

1. Chitinase and Laminarinase Production in Liquid Culture by *Trichoderma* spp. and Their Role in Biocontrol of Wood Decay Fungi

Bruce, A.; Srinivasan, U.; Staines, H.J.; Highley, T.L.
1995. Int. Biodeter. & Biodegrad. 337–353.

This paper describes macro- and microassay methods to assess the production of the lytic enzymes laminarinase and chitinase, by a range of Trichoderma isolates, and investigates the effect of nutrient composition, glucose amendment, and the addition of basidiomycete cell wall material on the production of these lytic enzymes.

2. Comparative Durability of Untreated Wood in Use Above Ground

Highley, T.L.
1995. Int. Biodeter. & Biodegrad. 409–419.

Cross-brace units constructed of 10 different softwoods and 9 different hardwoods were exposed on a test fence in Wisconsin for up to 22 years. Sapwood was included for all species and heartwood for some. The objective of this study was to determine the above-ground longevity of these woods against decay.

3. Western Wood Species Treated With Chromated Copper Arsenate: Effect of Moisture Content

LeBow, S.T.; Morrell, J.J.; Milota, M.R.
1996. Forest Prod. J. 46(2): 67–70.

This report describes how drying to varying moisture levels affects chromated copper aresenate (CCA) treatment of lumber on six hem-fir species plus Douglas-fir.

4. Preservative Treatment of Red Maple

Smith, William B.; Abdullah, Nazri; Herdman, Douglas; De Groot, Rodney C.
1996. Forest Products J. 46(3): 35–41.

The development of additional preservative treatments for underutilized eastern hardwoods, such as red maple, is critical to the development of new market opportunities that require long-term utilization of hardwoods in exterior structures. This project investigated the treatability of red maple sapwood and heartwood with water, toluene, CCA (chloromated copper arsenate), ACQ (ammonium copper didecyldimethylammonium chloride), creosote, and tolene- and waterborne copper naphthenate. The efficacy of CCA and water- and oilborne copper naphthenate against a brown-rot fungus (*Postia placenta*), a white-rot fungus (*Trametes versicolor*), and a soft-rot fungus (*Chaetomium globosum*) was also determined using sapwood blocks in agar block decay tests.

Engineering Properties and Design Criteria

5. Laminating Effects in Glued-Laminated Timber Beams

Falk, Robert H.; Colling, François.
1995. J. Struct. Eng. 121(12): 1857–1863.

This paper discusses the laminating effect and quantifies its magnitude based on both European and North American lamination tensile strength and glulam beam bending strength data.

Wood

Forest Products Laboratory.
1996. *In*: Avallone, Eugene A.; Baumeister, Theodore III, eds. Marks' standard handbook for mechanical engineers. New York: McGraw–Hill. 10th ed. Chap. 6.7

Available from McGraw–Hill, Inc., P.O. Box 545, Blacklick, OH 43003–0545. 1-800-722–4726. ISBN# 0070049971. Cost: $125.

This chapter presents authoritative information for both the practicing engineer and the student on the following mechanical engineering topics relating to wood: composition, structure, and nomenclature; physical and mechanical properties of clear wood; properties of lumber products; properties of structural panel products; and durability of wood in construction.

6. Field Performance of Timber Bridges—5. Little Salmon Creek Stress-Laminated Deck Bridge

Ritter, Michael A.; Kainz, James A.; Porter, Gregory J.
1996. USDA Forest Serv. Res. Pap. FPL–RP–547. 15 p.

This report, the fifth in a series, documents the results from the FPL bridge monitoring program. This paper describes the development, design, construction, and field performance of the Little Salmon Creek bridge on the Allegheny National Forest in Pennsylvania.

7. Moisture Control in Crawl Spaces

Rose, William B.; TenWolde, Anton.
1994. Wood Design Focus. 5(4): 11–14.

In this study, the need for crawl-space ventilation is examined. Research findings are summarized related to moisture release from the soil, site drainage, the effect of ground covers, ventilation, and the effect of crawl-space conditions on indoor air quality.

8. Performance Level 2 and Test Level 4 Bridge Railings for Timber Decks

Rosson, Barry T.; Faller, Ronald K.; Ritter, Michael A.
1995. In: Transportation Research Board. Highway and facility design; highway operations, capacity, and traffic control: geometric design, roadside safety features, roadside hardware monitoring, and scenic loop tours. Transportation Research Record 1500. Washington, DC: National Academy Press: 102–111.

The Midwest Roadside Safety Facility, in cooperation with the Federal Highway Administration and USDA Forest Service, Forest Products Laboratory, developed and tested two bridge railings for use on longitudinal timber bridge decks: (a) a steel railing system (TBC-800) and (b) a glulam timber railing system (GC-8000). The test for the TBC-8000 was conducted according to performance level 2 as specified in the AASHTO *Guide Specifications for Bridge Railings*. The tests for the GC-8000 were conducted according to test level 4 as specified in NCHRP *Report 350*. This paper describes the results from those tests.

9. Efficient Use of Red Oak for Glued-Laminated Beams

Shedlauskas, J.P.; Manbeck, H.B.; Janowiak, J.J.; Hernandez, R.; Moody, R.C.; Labosky, P., Jr.; Blankenhorn, P.R.
1996. ASAE. American Society of Agricultural Engineers. 39(1): 203–209.

The objectives of this research were to (1) develop a red oak glued-laminated combination, using a high percentage of No. 2 grade material, with a 16.5 MPa bending design value and a 12.4 GPa design stiffness, (2) determine if the volume effect model currently in use for softwoods, yellow poplar, and red maple can be applied to red oak glued-laminated beams, and (3) determine if ASTM D 3737 procedures satisfactorily predict the bending design stress and modulus of elasticity of a red oak glued-laminated beam.

10. Moisture Accumulation in Walls: Comparison of Field and Computer-Predicted Data

TenWolde, A.; Carll, C.
1995. *In*: Thermal performance of the exterior envelopes of buildings VI. Proceedings of a conference; 1995, December 4–8; Clearwater Beach, FL. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.: 297–305.

The first objective of this study was to estimate the accuracy of a dynamic hourly moisture computer model, such as MOIST, by comparing modeling results with measured data. The second objective was to identify the differences between those results and results obtained with a steady-state calculation method and to assess under what conditions use of such a simplified method may be justified.

11. Moisture Control Strategies for the Building Envelope

TenWolde, Anton; Rose, William B.
1994. Wood Design Focus. 5(4): 7–10.

Moisture control in buildings is essential to both the inhabitants and the structural performance. This paper describes two alternative moisture-control strategies. In the first approach, moisture is limited from internal and external sources. The second approach involves constructing for moisture tolerance by preventing entry of liquid water, protecting against air leakage, and appropriately placing vapor retarders.

Locating Butt-Joints in Four-Layer Nail-Laminated Assemblies

Williams, G.D.; Bohnhoff, D.R.; Moody, R.C.
1996. Trans. Am. Soc. Agric. Eng. 39(2): 699–711.

Available from Transactions of ASAE, 2950 Niles Road, St. Joseph, MI 49085. Cost: $7.25

The objectives of this study were to (1) validate finite element analysis as a method of predicting the behavior of spliced, four-layer nail-laminated assemblies, and (2) use finite element analysis to determine how changes in splice arrangement, overall splice length, joint spacing, and butt-joint reinforcement affect bending strength and stiffness of spliced, four-layer nail-laminated assemblies.

12. Effects of Waterborne Preservative Treatment of Mechanical Properties: A Review

Winandy, Jerrold E.
1995. *In*: Proceedings, 91st annual meeting of American Wood-Preservers' Association; 1995, May 21–24; New York, NY. Woodstock, Maryland: American Wood-Preservers' Association: 17–33.

This paper reviews the effects of preservative treatment of the mechanical properties of wood, especially waterborne preservative treatment. Where appropriate, limitations are discussed that have been implemented in treating standards to control the preservative treatment effects of strength. In the final section of this paper, modifications to allowable design stresses are discussed.

13. Kinetic Models for Thermal Degradation of Strength of Fire-Retardant-Treated Wood

Winandy, Jerrold E.; Lebow, Patricia K.
1996. Wood and Fiber Sci. 28(1): 39–52.

The objective of this study was to use the combined data set from previous studies to compare previous models and to develop an optimal mechanistic reaction-rate model based on kinetic theory. That model can then be used to identify those fire-retardant chemicals that are most susceptible to accelerated thermal degradation and to provide guidance on in service temperature levels at which that acceleration might occur.

14. Experimental Assessment of Wood Trusses With Square-End Webs

Wolfe, Ronald W.; Stahl Doug; Cramer, Steve.
1996. USDA Forest Serv. Res. Pap. FPL–RP–544. 19 p.

This paper discusses the design, fabrication, and testing of light-frame trusses to provide a basis for assessing the effect of square-end webs on truss stiffness and strength.

15. Design of Glued Laminated Timber Columns

Zahn, John J.; Rammer, Douglas, R.
1995. J. Struct. Eng. 121(12): 1789–1794.

The column design criterion adopted in the 1991 National Design Specification contains a parameter *c* that depends on homogeneity and straightness. The objective of this study was to determine whether the improved homogeneity and initial straightness of laminated members are sufficient to justify a more liberal *c* value for glued laminated (glulam) compared with that of solid-sawn lumber.

Fiber and Particle Products

16. Waste-Wood-Derived Fillers for Plastics

English, Brent; Clemons, Craig M.; Stark, Nicole; Schneider, James P.
1996. USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–91. 15 p.

This report represents the culmination of Project 94–55 for the Solid Waste Reduction and Recycling Demonstration Grant Program of the Wisconsin Department of Natural Resources. The project was conducted from July 1, 1994, through February 29, 1996.

17. Property Enhancement of Wood Composites Using Gas Injection

Geimer, Robert L.; Leao Alcides; Armbruster, Dave; Pbalo, Arturo.
1994. *In*: Maloney, Thomas M., ed. Proceedings of the 28th Washington State University international particleboard/ composite materials symposium; 1994 April 12–14; Pullman, WA. Pullman, WA: Washington State University: 243–259.

This paper presents the results of several studies conducted for the past few years at the Forest Products Laboratory in Madison, Wisconsin, that investigated the introduction of three different gases into wood composites. Gases under consideration were methyl borate, methyl formate, and carbon dioxide.

18. Classification of Wood Surface Features by Spectral Reflectance

Lebow, Patricia K.; Brunner, Charles C.; Maristany, Alberto G.; Butler, David A.
1996. Wood Fiber Sci. 28(1): 74–90.

This paper describes how principal-component analysis can be used to model spectral-reflectance curves and classify wood-surface features on the basis of their spectral reflectances.

19. Swelling of Compressed Cellulose Fiber Webs in Organic Liquids

Mantanis, G. I.; Young, R.A.; Rowell, R.M.
1995. Cellulose. 2: 1–22.

In this investigation, an analysis is made of cellulose swelling in liquids that generally do not affect the crystalline structure of cellulose.

20. A New Generation of Composite Materials From Agro-Based Fiber

Rowell, Roger M.
1995. *In*: Prasad, P.N.; Mark, James E.; Fai, Ting Joo, eds. Polymers and other advanced materials: emerging technologies and business opportunities. Proceedings of the 3d international conference on forntiers of polymers and advanced materials; 1995 January 16–20; Kuala Lumpur, Malaysia. New York, NY: Plenum Press: 659–665.

Agro-based fibers are classified according to what part of the plant they come from. Five different fiber classifications are discussed in this report: (1) bast or stem fibers; (2) leaf fibers; (3) seed-hair fibers; (4) core, pith, or stick fibers; and (5) all other plant fibers.

21. Utilization of Recycled Agriculture-Based Fiber for Composites

Rowell, Roger M.
1995. *In*: Rader, Charles Pl; Baldwin, Sheryl D.; Cornell, David D. [and others], eds. Plastics, rubber, and paper recycling: a pragmatic approach. ACS sumpsium series 609. Proceedings, 208th national meeting American Chemical Society; 1994 August 21–25; Washington, DC. Washington, DC: American Chemical Society: 357–366. Chap. 29.

The purpose of the research presented in this paper is to describe the potential for producing structural composites from waste wood, paper, agricultural residues, and other forms of agro-resources. For comparison, a mixed hardwood fiber and hemlock fiber are included. The properties of all boards are compared to minimum standards as outlined by the American Hardboard Association.

22. Dimensionally Stabilized, Very Low Density Fiberboard

Rowell, Roger M.; Kawai, Shuichi; Inoue, Masafumi
1995. Wood Fiber Sci. 27(4): 428–436.

The purpose of this research was to produce very low density fiberboard using acetylation and steam treatments to improve dimensional stability and determine physical properties of boards in dry and wet conditions.

23. Renewable Agricultural Fibers as Reinforcing Fillers in Plastics: Mechanical Properties of Kenaf Fiber–Polypropylene Composites

Sanadi, Anand R.; Caulfield Daniel F.; Jacobson, Rodney E.; Rowell, Roger M.
1995. Ind. Eng. Chem. Res. 34(5): 1889–1896.

In this study, the mechanical properties of kenaf–polypropylene composites are evaluated. The effect of the fiber content on the tensile, flexural, and impact properties of the composites was determined. The use of a maleated polypropylene to improve the fiber–matrix interaction and adhesion are discussed in regards to why and how they function to improve properties.

24. Machine Direction Strength Theory of Corrugated Fiberboard

Urbanik, T.J.
1996. J. Composite Technol. & Res. 18(2): 80–88.

The objective of this paper is to broaden the buckling theory previously applied to cross-machine-direction-loaded corrugated fiberboard and thereby predict the strength of direction of machine-loaded fiberboard.

25. Unlikely Partners? The Marriage of Wood and Nonwood Materials

Youngquist, John A.
1995. Forest Prod. J. 45(10): 25–30.

This paper looks at a number of "nonconventional" composites that combine wood fibers, particles, flakes, or lumber with other materials like plastics, cement, and gypsum. These combinations create enormous opportunities to match product performance to end-use requirements.

Fire Safety

26. Room/Corner Tests of Wall Linings With 100/300 kW Burner

Dietenberger, Mark A.; Grexa, Ondrej; White, Robert H..; Sweet, Mitch; Janssens, Marc
1995. *In*: Proceedings, 4th international fire and materials conference; 1995 November 15–16; Crystal City, WA. London, UK: Inter Science Communications Limited: 53–62.

The first part of this paper describes the room/corner tests for six selected materials with fire performance characteristics spanning a relatively wide range. The second part describes the correlation of time to flashover with cone calorimeter data and with flame spread index of ASTM #84 using a rudimentary flame spread model.

27. Fire Performance of Wood Treated With Combined Fire-Retardant and Preservative Systems

Sweet, Mitchell S.; Levan, Susan L.; White, Robert H.; Tran, Hao C.; De Groot, Rodney
1996. USDA Forest Serv. Res. Pap. FPL–RP–545. 10 p.

This paper discusses the fire tests conducted on selected combinations of fire retardants and preservatives.

Microbial and Biochemical Technology

28. Polycyclic Aromatic Hydrocarbon-Degrading Capabilities of *Phanerochaete laevis* HHB-1625 and Its Extracellular Ligninolytic Enzymes

Bogan, Bill W.; Lamar, Richard T.
1996. Appl. Environ. Microbiol. 62(5): 1597–1603.

The objective of the present study was to characterize the PAH-degrading capacity of *Phanerochaete laevis* HHB-1625 and its extracellular enzymes. This strain had been previously identified in screening studies as having above-average pentachlorophenol-mineralizing ability relative to other *Phanerochaete* species. This paper details the results of this work.

29. Fluorene Osidation in Vivo by *Phanerochaete chrysosporium* and in Vitro during Manganese Peroxidase-Dependent Lipid Peroxidation

Bogan, Bill W.; Lamar, Richard T.; Hammel, Kenneth E.
1996. Appl. Environ. Microbiol. 62(5): 1788–1792.

This study sought to determine whether transformation of fluorene occurs during the lipid peroxidation reactions mediated by *P. chrysosporium* peroxidases.

30. Degradation of 4,4'-Dichlorobiphenyl, E,e',4,4'-Tetrachlorobiphenyl, and 2,2',4,4',5,5'-Hexachlorobiphenyl by the White Rot Fungus *Phanerochaete chrysosporium*

Dietrich, Diane; Hickey, William J.; Lamar, Richard
1995. Applied and Environ. Microbiol. 61(11): 3904–3909.

The white rot fungus *Phanerochaete chrysosporium* has demonstrated abilities to degrade many xenobiotic chemicals. In this study, the degradation of three model polychlorinated biphenyl congeners (4,4'-dichlorobiphenyl, 3,3'4,4'-tetrachlorobiphenyl, and 2,2',4,4',5,5'-hexachlorobiphenyl) by *P. chrysosporium* in liquid culture was examined.

31. Structure, Inheritance, and Transcriptional Effects of Pce 1, an Insertional Elemen t Within *Phanerochaete chrysosporium* Lignin Peroxidase Gene *lipI*

Gaskell, Jill; Wymelenberg, Amber Vanden; Cullen, Daniel
1995. Proc. Natl. Acad. Sci. 92(8): 7465-7469. Biochemistry.

This paper reports on a 1747-bp insertion within a LiP gene of *P. chrysosporium.* Pce 1, the transposon-lie element, is inherited in a simple Mendelian fashion and directly affects the expression of *lipI*2. The copy number, inheritance, genomic location, and distribution of Pce 1 are investigated.

32. *Phanerochaete chrysosporium* Glyoxal Oxidase is Encoded by Two Allelic Variants: Structure, Genomic Organization, and Heterologous Expression of *glx1* and *glx2*

Kersten, Philip J.; Witek, Christian; Wymelenberg, Amber Vanden; Cullen, Daniel.
1995. J. Bacteriol. 177(11): 6106–6110.

A cDNA clone (glx-2c) encoding glyoxal oxidase (GLOX) was isolated from a *Phanerochaete chrysosporium* λgt11 library, and its nucleotide sequence was shown to be distinct from that of the previously described clone glx-1c. Genomic clones corresponding to both cDNAs were also isolated and sequenced.

33. Physiological Regulation of Glyoxal Oxidase From *Phaneorchaete chrysosporium* by Peroxidase Systems

Kurek, Bernard; Kersten, Philip J.
1995. Enzyme Microb. Tech. 17(8): 751–756.

The emphasis of this study was to characterize the reversible inactivation and reactivation of GLOX in uncoupled and peroxidase-coupled reactions. Effects of pH, peroxide concentration, peroxidase source (fungal versus plant), and peroxidase substrate on GLOX activity were determined.

34. A Variable-Tilt Fermentation Rack for Screening Organisms in Microfuge Tubes

Sreenath, Hassan K.; Jeffries, Thomas W.
1996. Biotechnol. Tech. 10(4): 239–242.

In this study, a variable-tilt microfuge fermentation rack to screen liquid cultures of wild and mutant yeasts for ethanol production was designed. The rack design allows for the evaluation of up to 40 cultures in the space normally required for three 125-mL flasks.

35. Efficient Expression of a *Phanerochaete chrysosporium* Manganese Peroxidase Gene in *Aspergillus oryzae*

Stewart Philip; Whitwam, Ross E.; Kersten, Philip J.; Cullen, Daniel; Tien, Ming.
1996. Appl. Environ. Microbio. 62(3): 860–864.

A manganese peroxidase gene (*mnpl*) from *Phanerochaete chrysosporium* was efficiently expressed in *Aspergillus oryzae*. Expression was achieved by fusing the mature cDNA of *mnpl* with the *A. oryzae* Taka amylase promoter and secretion signal. The # foot untranslated region of the glucoamylase gene of *Aspergillus awamori* provided the terminator. The recombinant protein (rMnP) was similar to those of the native protein. The *A. oryzae* expression system is well suited for both mechanistic and site-directed mutagenesis studies.

36. Fed-Batch Culture for Xylitol Production by *Candida boidinii*

Vandeska, Eleonora; Amartey, S.; Kuzmanova, Slobodanka; Jeffries, T.W.
1996. Process Biochem. 31(3): 265–270.

In this study, Xylitol production by *Candida boidinii* NRRL Y-17213 was investigated in fed-batch fermentation with xylose (50, 100 g litre^{-1}) and a mixture of glucose (25 g litre^{-1}).

Mycology

37. A Proposed Model of the Tracheid Cell Wall of Southern Yellow Pine Having an Inherent Radial Structure in the S_2 Layer

Larsen, Michael J.; Winandy, Jerrold E.; Green, Frederick, III.
1995. Mater. und Organ. 29: 197–210.

The purpose of this paper is to propose that our earlier and present observations and those of J. Sell and T. Zimmermann on wood cell wall structure, using different methodologies, support a new hypothesis: that although concentric layering in the S_2 may indeed exist, there are also thin radial bands of hemicellulose adjacent to the crystalline microfibril bundles that act as an inherent plane of weakness within the ultrastructure of the S_2 cell wall.

38. Fungal Communities in Wet Tropical Forests: Variation in Time and Space

Lodge, D. Jean; Cantrell, Sharon
1995. Can. J. Bot. 73(Suppl. 1): S1391–Í1398.

The primary objective of this paper is to review the literation on vertical stratification, small-scale spatial heterogeneity on the forest floor, and temporal variation in certain fungal communities in wet and moist tropical forests. Some original data on spatial patterns of basidiomycete communities in the litter layer are included to complement the published literature.

39. Diversity of Litter Agarics at CuYabeno, Equador: Calibrating Sampling Efforts in Tropical Rainforest

Lodge, D. Jean; Cantrell, S.
1995. Mycologist. 9(4): 149–151.

This study was conducted to determine what area needs to be sampled in order to determine the diversity of litter agarics in a wet mainland neotropical forest.

40. A Survey of Patterns of Diversity in Non-Lichenized Fungi

Lodge, D. Jean; Samuels, Chapela, G.; Uecker, F.A. [and others]
1995. Mitt. Eidgenöss, Forsch. anst. Wald Schnee Landsch. 70(1): 157–173.

This paper summarizes the opinions of 26 mycologists who have worked in more than one hemisphere or continent regarding the locations, correlates, and potential cause of centers of fungal endemism and diversity in non-lichenized fungi. These views were obtained by a survey and summarized by the lead author.

Processing of Wood Products

41. Mathematical Relationship Between Surface Emission and Diffusion Coefficients

Liu, Jen Y.; Simpson, William T.
1996. Drying Technol. 14(3&4): 677–699.

This paper analyzes the surface emission coefficient corresponding to any diffusion coefficient expressed as an exponential function of the concentration of diffusing substance in capillary porous solids. Theoretical equations for surface emission coefficient for both sorption and desorption are presented. Procedures to derive the diffusion coefficient and to verify the corresponding surface emission coefficient are made using experimental sorption data of aspen (*Populus* sp.) wood.

42. Hardwood Sawing Technology in Five Tropical Countries

Loehnertz, Stephen P.; Cooz, Iris Vazquez; Guerrero, Jorge
1996. Forest Prod. J. 46(2): 51–56.

In this study, hardwood sawing technology is described in five tropical countries: Ghana, Brazil, Venezuela, Indonesia, and Malaysia. Density of the wood and presence of silica make it a challenge to saw many tropical hardwoods.

43. Nondestructive Evaluation of Green Defect-Prone Red Oak Lumber: A Pilot Study

Ross, Robert J.; Fuller, James J.; Dramm, John R.
1995. Forest Prod. J. 45(11/12): 51–52.

Honeycomb and surface checks are lumber drying defects that can go undetected and result in considerable losses during further processing of the lumber into products. This paper summarizes results of a pilot study designed to investigate use of ultrasonic nondestructive evaluation techniques to identify sections of green lumber that would form honeycomb and surface checks during drying.

44. Nondestructive Evaluation of Wetwood and Honeycomb

Ross, Robert J.; Fuller, James J.; Dramm, John R.
1995. *In*: Lowery, Glenn; Meyer, Dan, eds. Advances in hardwood utilization: Following profitability from the woods through rough dimension: Proceedings of the 23d annual hardwood symposium; 1995 May 17–20; Cashiers, NC. Memphis, TN: National Hardwood Lumber Association: 61–67.

Lumber drying defects in the form of surface checks and honeycomb are especially severe in oak lumber and constitute a major source of value loss and waste. The Forest Products Laboratory, USDA Forest Service, has been involved in research aimed at developing a low-cost, industrial-type detection system to identify wetwood in green hardwood lumber and honeycomb in dry lumber. This report summarizes the results of a series of laboratory studies and equipment development efforts.

45. Nondestructive Methods for Detecting Defects in Softwood Logs

Schad, Kristin C.; Schmoldt, Daniel L.; Ross, Robert J.
1996. USDA Forest Serv. Res. Pap. FPL–RP–546. 13 p.

This paper briefly describes sound wave transmission, x-ray CT, and impulse radar and reports the results of tests using these nondestructive evaluation methods.

46. Method to Estimate Dry-Kiln Schedules and Species Groupings

Simpson, William T.
1996. USDA Forest Serv. Res. Pap. FPL–RP–548. 57 p.

This report investigates the possibility of estimating kiln schedules and grouping species for drying using basic specific gravity as the primary variable for prediction and grouping.

Pulp, Paper, and Packaging

Semianual Conference Review—July–December 1995

Doshi, Mahendra R.; Scott, Gary M.; Borchardt, John K.
1996. Progress in Paper Recycling. 5(3): 81–93.

Available from: Progress in Paper Recycling, P.O. Box 2771, Appleton, WI 54913–2771. Cost: $13.50.

This paper summarizes recycling related articles presented at four conferences. A total of 65 papers were presented at these conferences. Highlights of some important research results and ideas discussed at these conferences are presented.

47. Differential and Synergistic Action of *Streptomyces* Endoxylanases in Prebleaching of Kraft Pulps

Elegir, Graziano; Sykes, Marsguerite; Jeffries, Thomas W.
1995. Enzyme Microbial Tech. 17: 954–959.

Microbial endoxylanases reduce chemical demand when they are applied to pulps prior to bleaching sequences. However, their mechanism of action is not fully understood, and the criteria for determining which enzymes are most effective are not well known. This study examined the effects of two types of well-characterized endoxylanases from *Streptomyces* sp. TUB B-12-2 on the bleachability of kraft softwood and hardwood pulps.

48. Industrial Scaleup of Enzyme-Enhanced Deinking of Nonimpact Printed Toners

Heise, Oliver U.; Unwin, Jay P.; Klungness, John H.; Fineran, William G., Jr.; Sykes, Marguerite; Abubakr, Said
1996. Tappi J. 79(3): 207–212.

This report focuses on improving final pulp quality of recycled sorted postconsumer paper so that the recycling of lower quality postconsumer paper can be studied. Results of enzyme-enhanced, continuous, single-stage flotation pilot plant trials are discussed, and fiber and handsheet properties of the deinked pulp are presented. This trial used industrial-sized equipment.

49. Effect of Fiber Loading on Paper Properties

Klungness, John H.; Sykes, Marguerite S.; Tan, Freya; Abubakr, Said; Eisenwasser, Jacob D.
1996. Tappi J. 79(3): 297–301.

This study examined the effect on paper properties of fiber-loaded calcium carbonate compared with conventional, direct-loaded calcium carbonate. Research in this area has developed the basic technology for a process of precipitating and loading calcium carbonate within and on papermaking fibers.

50. Local Strain Fields in Paper

Korteoja, M.J.; Lukkarinen, A.; Kaski, K.; Gunderson, D.E.; Dahlke, J.L.; Niskanen, K.J.
1996. Tappi J. 79(4): 217–223.

In this study, the localization of plastic strain and ultimate failure on the length scale of fiber flocs using experiments and computer simulations is studied. In addition, the statistical effects of the formation-like randomness in paper structure are emphasized.

51. Reaction of *p*-Hydroxycinnamyl Alcohols With Transition Metal Salts. 2. Preparation of Guaiacyl/Syringyl Di-, Tri-, and Tetralignols

Landucci, Lawrence L., Luque, Susana; Ralph, Sally
1995. J.Wood Chem. Technol. 15(4): 493–513.

The first paper of this series described the oligomerization and polymerization of coniferyl alcohol (CA) with salts of iron, cobalt, and manganese. In that work a variety of products, ranging from dilignols to polylignols (DHPs), was obtained. Although the initial reaction step in oxidation of CA by metal salts is presumably the same as that in the H_2O_2/peroxidase system (phenoxy radical formation), the additional flexibility and lack of enzyme-imposed restraints on reaction conditions resulted in a broad array of products and linkage distribution. The present work extends the technique to oxidation of sinapyl alcohol (SA) and to CA/SA mixtures and concentrates on obtaining all of the possible guaiacyl (G) and syringyl (S) dilignols with ß-O-4; ß-5, or ß-ß linkages.

52. Refiner Mechanical and Biomechanical Pulping of Jute

Sabharwal, Harmohinder, S.; Akhtar, Masood; Blanchette, Robert A.; Young, Raymond A.
1995. Holzforschung. 49(6): 537–544.

Atmospheric refiner mechanical pulping of untreated and fungal- and alkali-treated jute bast was explored in this present investigation. Hammermilled and cut jute bast strands were refined in a laboratory single disc refiner under atmospheric conditions.

53. Spaceboard II Panels: Preliminary Evaluation of Mechanical Properties

Scott, C. Tim; Laufenberg, Theodore L.
1995. Wood Fiber Sci. 27(4): 402–412.

The objective of this study was to characterize, under dry conditions, the basic mechanical properties of Spaceboard II. These evaluations will provide the basis for determining the potential of Spaceboard II as a structural-use panel. A variety of standard tests were conducted to measure various panel properties: bending stiffness and strength, concentrated load application, bearing strength, and interlaminar shear. In addition, coupons were extracted from specific facing locations to measure tensile and compression properties.

54. New Facile Syntheses of Monolignol Glucosides; *p*-Glucocoumaryll Alcohol, Coniferin and Syringin

Terashima, Nortisugu.; Ralph, Sally A.; Landucci, Lawrence L.
1996. Holzforschung. 50(2): 151–155.

This study developed a new procedure for synthesizing the monolignol glucosides *p*-glucocoumaryl alcohol, coniferin and syringin, (VIIa, VIIb, and VIIc) from the corresponding acetylglucocinnamic acid esters (VIIIa, VIIIb, and VIIIc) in good yield.

55. New Preparations of Lignin Polymer Models Under Conditions That Approximate Cell Wall Lignification—I. Synthesis of Novel Lignin Polymer Models and their Structural Characterization by ^{13}C NMR

Terashima, N.; Atalla, R.H.; Ralph, S.A.; Landucci, L.L.; Lapierre, C.; Monties, B.
1995. Holzforschung. 49(6): 521–527.

In this study, guaiacyl-type lignin polymer models were prepared from coniferin by the action of ß-glucosidase and peroxidase, with hydrogen peroxide generated *in situ* through the action of oxygen and glucose oxidase on the glucose liberated from the coniferin. Polylignols were also prepared from coniferyl alcohol using procedures modified to closely correspond to conditions prevailing in the cell wall environment. The structure of these novel polylignols approximated that of native lignin more closely than did the structure of polylignols prepared by the conventional method from coniferyl alcohol.

56. Heterogeneity of Lignin Concentration in Cell Corner Middle Lamella of White Birch and Black Spruce

Tirumalai, V.C.; Agarwal, U.P.; Obst, J.R.
1996. Wood Sci. Technol. 30: 99–104.

In this study, Raman microprobe spectroscopy was used to study the concentration of lignocellulosics in the cell corner middle lamella.

Effects of Operating Variables on Ultrafiltration of Flexographic Pigments from Wash De-inking Filtrate

Upton, Bradley H.; Cullinan Harry T.; Abubakr, Said; Krishnagopalan, Gopal, A.
1996. Appita: 25–31.

Available from Appita, Suite 47, Carlton Clocktower, 255 Drummond Street, Carlton, Vic 3053 Australia. Cost: $90.

This paper describes the results of a statistically designed experimental sequence tailored to optimize the ultrafiltration process for clarifying flexographic pigment dispersions. The operational parameters investigated include temperature, pigment concentration, and surfactant concentration.

57. Alkaline-Active Xylanase Produced by an Alkaliphilic *Bacillus* sp. Isolated From Kraft Pulp

Yang, V.W; Zhuang, Z; Elegir, G.; Jeffries, T.W.
1995. J. Indus. Microbiol. 15: 434–441.

This study reports the characteristics of a *Bacillus* sp (VI–4) that were isolated from fresh hardwood pulp. The organism is capable of growing in diluted black liquor at pH 11.5 and producing high levels of xylanase when cultivated in alkaline medium.

Timber Demand and Technology Assessment

58. Recycling of Wood and Paper Products in the United States

Ince, Peter J.
1996. USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–89. 10 p.

This report describes the current status of wood and paper recycling in the United States and predicts the production and market consequences of increased recycling. The information presented here was prepared for the United Nation s Economic Commission in June 1994. Historical data were derived from various sources, including government agencies and industry trade associations. Economic projections were developed by the author and others in the USDA Forest Service.

59. Building Partnerships to Evaluate Wood Utilization Options for Improving Forest Health

Skog, Kenneth; Green, David; Barbour, R. James; Baumgras, John; Clark, Alexander, III; Mason, Andrew; Meriwether, David; Myers, Gary
1995. *In*: Eskey, Lane G., comp. Forest health through silviculture: Proceedings of the 1995 National silviculture workshop: 1995 May 8–11; Mescalero, New Mexico. Gen.. Tech. Rep. RM–GTR–267. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 153161.

Silvicultural practices used on national forests are changing as a result of the shift to ecosystem management. As a result, the species mix, size, quality, and quantity of wood material that may be removed are changing. In a combined, multidisciplinary effort, Forest Service research units have been identifying wood utilization options for managing specific ecosystems. Teams have been focusing research on three conditions: dense small-diameter stands in the West, uneven-aged pine/mixed hardwood stands in the South, and central Appalachian hardwood forests in the Northeast. The teams are evaluating alternatives for silvicultural treatments, forest operations, wood products, and the economic feasibility of these alternatives. The project objective is to provide information and methods for evaluating opportunities for current and future products from woody materials that may be removed from the forests.

60. Wood Products Technology Trends

Skog, Kenneth E.; Ince, Peter J.; Dietzman, Debra J.S.; Ingram, C. Denise
1995. J. Forestry. 93(12): 30–33.

This paper is a discussion on forest products technology changes in response to changing costs, market conditions, and availability or scarcity of forest resources. In the future, technologies will continue to adapt as the types of raw materials from forests become more diverse. Technology will also seek to use wood and fiber from other sources, such as recyclable materials. A number of key developments in structural wood products technologies, as well as pulp and paper technologies, are already changing the wood manufacturing process and affecting how timber is used.

61. Capacity, Production, and Manufacture of Wood-Based Panels in the United States and Canada

Spelter, Henry
1996. USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–90. 17 p.

Information in this paper is presented for four panel manufacture sectors: oriented strandboard, Southern Pine plywood, particleboard, and medium-density fiberboard. Data are based on information obtained from a collection of sources, including the Census of Manufactures, private and public timber market price reporting agencies, publications on panel market prices, trade association surveys, company financial reports, and trade journals.

Wood Bonding Systems

Wood Adhesives 1995

1996. In: Christiansen, Alfred W.; Conner, Anthony H., eds. Wood Adhesives 1995. Proceedings of a symposium; 1995, June 29–30; Portland, OR. Proc. 7296. ISBN 0-935018-79-4. Madison, WI: Forest Products Society.

Available from: Forest Products Society, 2801 Marshall Court, Madison, WI 53705-2295. Cost: $45 members, $55 nonmembers.

Hydroxymethylated Resorcinol Coupling Agent for Enhanced Adhesion of Epoxy and Other Thermosetting Adhesives to Wood by Vick, Charles B.

Chemical Modification of Wood for Improved Adhesion in Composites by Rowell, Roger M.

Analysis of Volatile Organic Chemical Emissions from Particleboard by Baumann, Melissa G.D.; Batterman, Stuart A.; Zhang, Guo–Zheng; Conner, Anthony H.

Durable Wood Adhesives from Furfural-Based Diisocyanates by Coppock, Kathleen M.; Holm, David R; Conner, Anthony H.; Hill, Charles G., Jr.

Modification of Urea-Formaldehyde Resin Adhesives: A Computational Study by Tang, Quan; Elder, Thomas; Conner, Anthony H.

Expanded Research and Development of Soybean-Based Wood Adhesives by Myers, Deland J.; Conner, Anthony H.; Dunn, Larson B., Jr.; Edwardson, Chris F.; Hanna, Milford A.; Hettiarachchy, Navam S.; Rhee, Khee C.

Phenolation of (+)-Catechin with Mineral Acids: Preliminary Results by Peng, Weiling; Conner, Anthony H.; Hemingway, Richard W.

62. Kinetics of the Liquid Phase Hydrogenation of Furan Aminesss

Holm, David R.; Hill, Charles G., Jr.; Conner, Anothy H.
1995. Ind. Eng. Chem. Res. 34(10): 3392–3398.

The liquid phase hydrogenation reactions of both furfurylamine and 5,5′-ethylidenedifurfurylamine to the corresponding tetrahydrofuran compounds were investigated over a rhodium on alumina catalyst suspended in a methanol solution. The reactions were studied at 42.5 to 80.1°C and hydrogen pressures from 231 to 1380 kPa. The effects of the amount of catalyst and the concentrations of both reactants and products on the rates of these reactions were also investigated.

63. Interactions of Phenolic Resin Alkalinity, Moisture Content, and Cure Behavior

Lorenz, Linda F.; Christiansen, Alfred W.
1995. Ind. Eng. Chem. Res. 34(12): 4520–4523.

The research reported here shows that alkali content, extent of precure, and relative humidity affect the equilibrium moisture content of phenol–formaldehyde resol resins.

64. Outdoor Aging of Wood-Based Panels and Correlation With Laboratory Aging: Part 2.

Okkkonen, E. Arnold;; River, Bryan H.
1996. Forest Prod. J. 46(3): 68–74.

The main objectives of this study were to (1) expand the existing durability database of phenolic-bonded panels with test data from contemporary commercial panels, (2) compare the new and old panels, and (3) test correlations between outdoor and accelerated laboratory aging developed previously.

65. Phenol-Formaldehyde Plywood Adhesive Resins Prepared With Liquefied Bark of Black Wattle (*Acacia Mearnsii*)

Santana, Marcos A.E.; Baumann, Melissa G. D.; Conner, Anthony H.
1996. J.Wood Chem. Technol. 16(1): 1–19.
In this study, whole bark and tannin-free bark from black wattle were liquefied in phenol in the presence of sulfuric acid catalyst. The resulting solutions were reacted with formalin in basic solution to yield resol resins that had 33% of the phenol replaced by liquefied bark. Preparation of three-ply Southern Pine plywood showed that the resins made with liquefied whole bark performed better than those prepared with tannin-free bark.

Special Item

Wood Decks—Materials, Construction, and Finishing

McDonald, Kent A.; Falk, Robert H.; Williams, R. Sam; Winandy, Jerrold E.
1996. ISBN 0-935018-77-8. Madison, WI: Forest Products Society. 93 p.

Available from Forest Products Society, 2801 Marshall Court, Madison, WI 53705-2295. Cost: $19.95.

Several publications are available in the marketplace that describe deck architecture, layout, and construction sequences. The primary goal of this manual is to provide information on the lumber appropriate for deck construction, construction details and sizing for structural integrity, and guidelines for finishing and maintaining a wood deck for appearance and longevity. The intent is to provide enough information so that the deck builder can better understand why deck materials perform the way they do, how to avoid or minimize potential maintenance problems, and how to correct problems.

The first two chapters define basic terminology and provide some basic information on wood properties relevant to the lumber available for wood deck construction. These chapters also include information on lumber grades and preservative treatment standards. Chapter 3 describes the structural design of wood decks, focusing on post, beam, and joist sizing. This chapter also describes fastener selection and construction details best suited for exposed wood construction. Chapter 4 describes the finishing (staining or sealing) of wood decks and provide information on enhancing long-term performance. Chapter 5 outlines inspection and maintenance procedures for existing decks.

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